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PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of	EXPRESS MAIL LABEL NO.: *EL 884787144 US*
Charles J. STOUFFER *et al.*	
Serial No.: **09/434,507**	Group Art Unit: 3727
Filed: November 5, 1999	Examiner: S. Pollard
For: HIGH TEMPERATURE ISOSTATIC PRESSURE BONDING OF HOLLOW BERYLLIUM PRESSURE VESSELS USING A BONDING FLANGE	

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TRANSMITTAL LETTER

Hon. Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Enclosed please find the following:

1. Brief on Appeal (one original and two copies); and
2. Check for fee of $320.00 (appeal fee).

The Commissioner is hereby authorized to charge any fee deficiency, or credit any overpayment, to Deposit Account No. 18-1579. The Commissioner is also authorized to charge Deposit Account No. 18-1579 for any future fees connected in any way to this application. A duplicate copy of this letter is enclosed.

Respectfully submitted,
ROBERTS ABOKHAIR & MARDULA, LLC

Kevin L. Pontius
Reg. No. 37,512
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Date: October 31, 2001 | Atty. Dkt. No.: 2288-006

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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of

Charles J. STOUFFER *et al.*

Serial No.: **09/434,507** | Group Art Unit: 3727

Filed: November 5, 1999 | Examiner: S. Pollard

For: HIGH TEMPERATURE ISOSTATIC PRESSURE BONDING OF HOLLOW BERYLLIUM PRESSURE VESSELS USING A BONDING FLANGE

APPELLANT'S BRIEF ON APPEAL UNDER 37 C.F.R. § 1.192

Hon. Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

In accordance with the provisions of 37 C.F.R. § 1.192, Appellant submits the following:

I. REAL PARTY IN INTEREST

Based on information supplied by Appellant, and to the best of Appellant's legal representatives' knowledge, the real party in interest is the assignee, SWALES AEROSPACE.

II. RELATED APPEALS AND INTERFERENCES

Appellant, as well as Appellant's assigns and legal representatives are unaware of any appeals or interferences which will be directly affected by, or which will directly affect, or have a bearing on the Board's decision in the pending appeal.

III. <u>STATUS OF CLAIMS</u>

Claims 1 and 3-21 are currently pending. No claims have been allowed. Claim 2 has been canceled. Claims 1 and 3-21 are appealed. Claims 1 and 3-21, as finally rejected, are set forth in the attached Appendix.

IV. <u>STATUS OF AMENDMENTS</u>

No amendment has been filed subsequent to the final rejection.

V. <u>SUMMARY OF THE INVENTION</u>

Appellants' disclosed and claimed invention is directed to diffusion bonding of hollow pressure vessels. This has commercial importance in that it represents a safe and effective way of bonding beryllium and beryllium alloys.

As an initial matter, it is important to note that diffusion bonding is a term of art in the metal working field that has an art accepted meaning that distinguishes it from other sorts of metal joining.

Diffusion bonding is a bonding process by which two work pieces (each formed of the same metal) are joined to one another without using a filler metal and without either of the work pieces melting. Each of the pieces to be bonded has a nominally

flat surface. These two flat surfaces are butted up against one another and then a compressive force is applied to the pieces while the temperature is maintained at an elevated temperature that is below the melting point of the metal that the work pieces are made of. *See* specification at page 4, lines 18-23.

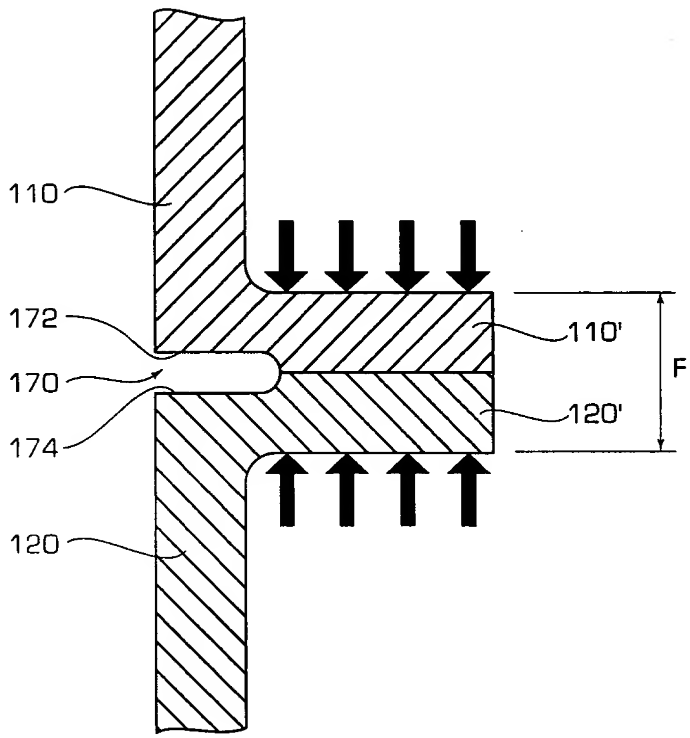
The physical process that occurs at the interface between the two abutted surfaces of the work pieces is a diffusion process. Technically, no melting occurs since there is no wholesale dissociation of the atomic bonds in the bulk of the work pieces. At the surface interface, however, the atomic bonds do shift about substantially so that the two surfaces may integrate together as a homogeneous bulk with no gap. When the temperature is lowered and the compression forces relieved, the atomic lattice is stable and essentially homogeneous. *Id.*, at page 5, lines 1-6.

One aspect of the present invention is a process for performing diffusion bonding. This is claimed in claims 1 and 3-6.

Special tooling is used to direct the compression force so that hollow beryllium articles can be formed effectively and reliably without crushing the article in the process. This is a very real concern since the hollow article can easily be crushed

at the temperature and pressure combination at which diffusion bonding needs to be done. When diffusion bonding can be used successfully, a hollow beryllium article can be formed without a seam of filler metal. *Id.*, at page 5, lines 11-16.

FIG. 3



An upper vessel blank is mated to a lower vessel blank so that their respective peripheral flanges meet to form a bonding flange F. This is illustrated conceptually, above, by a formally rendered version of Fig. 3 from the present application. A void is formed between the two blanks. An upper tooling member bears

down on the top of the bonding flange and a lower tooling member bears directly on the bottom of the bonding flange. Importantly, no pressure is brought to bear on the walls of the blanks of the article, only on the bonding flange formed by the combination of the peripheral flanges. *Id.*, at page 6, lines 4-11.

Another aspect of the present invention is a hollow pressure vessel (an article of manufacture) formed via the disclosed process for performing diffusion bonding. This is claimed in claims 15-20.

A third aspect of the present invention is a bond joint (an article of manufacture) formed via the disclosed process for performing diffusion bonding. This is claimed in claims 7-14 and 21.

The most significant disadvantage of beryllium as an industrial material, and one that is feared by anyone involved with beryllium processing, is the extreme toxicity of its fumes and dust. Indeed beryllium welding gives rise to toxic fumes that are one of the most feared environmental and lung damaging substances known. Exposure to beryllium particles can cause a serious illness called chronic beryllium disease, or CBD. CBD is characterized by an irreversible and sometimes fatal scarring of the lungs. CBD occurs in individuals who have become sensitized

to beryllium upon exposure. Not all people exposed to beryllium will become sick. However, there is currently no test available to find out who is sensitive to beryllium before exposure occurs. This makes beryllium welding a very feared and hazardous activity. Because welding melts the margins of the beryllium parts being joined, the fumes given off contain extreme amounts of potentially deadly beryllium particles. Once such particles enter a victim's lungs, the damage is virtually assured.

An additional drawback of welding beryllium is that it is necessary to use a filler metal. No one has yet devised a commercially viable way of welding beryllium without a filler metal. Since the joint is not pure beryllium, the joint is very weak compared to the surrounding bulk material and limits the joined assembly to low force applications. This defeats one of the main purposes of using beryllium in the first place, which is to take advantage of its high strength.

The same is true of brazing wherein molten filler metal is wetted to the surfaces of two parent metal parts that remain solid state. Although brazing of beryllium is believed not to give rise to the CBD risks associated with beryllium welding (because the parent metal does not melt in brazing), the brazing process yields a weak joint that defeats the usefulness of the

high strength properties of beryllium.

In contrast, diffusion bonding of beryllium is clean and safe. According to the process of the present invention, the beryllium is not melted and no fumes are generated. No toxic beryllium particles are released into the air.

Thus, the present invention makes it possible to join beryllium parts i) in a way that preserves the high strength properties of beryllium and ii) without killing anybody. These things were not possible in the prior art.

Although the claimed bonding process and articles of manufacture were developed in the context of manufacturing using beryllium, the results of this pioneering work have general applicability. It is not limited only to beryllium.

VI. ISSUES

There are two issues on appeal:

Issue A: Are claims 15-18 and 20 anticipated by Geiser, Jr. *et al.* (U.S.P. 2,941,064), within the meaning of 35 U.S.C. § 102(b)?

Issue B: Are claims 1, 3-14, 19, and 21 obvious over Geiser, Jr. *et al.*, within the meaning of 35 U.S.C. § 103(a)?

VII. GROUPING OF CLAIMS

The appealed claims stand or fall according to the following groupings:

Group 1	Claims 1 and 3-6.
Group 2	Claims 7-14, 19, and 21.
Group 3	Claims 15-18 and 20.

VIII. ARGUMENTS

Issue A => Are Claims 15-18 and 20 Anticipated?

Claims 15-18 and 20 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Gieser, Jr. *et al.* (U.S.P. 2,941,064). Appellant respectfully asks that this anticipation rejection be reversed for the following reasons.

In order for a claim to be anticipated, each and every limitation of the claim must be disclosed (expressly or inherently) within a single prior art reference. That is the law of anticipation. *See Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). *See also Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 9 U.S.P.Q.2d 1913 (Fed. Cir. 1989); *In re Bond*, 910 F.2d 831, 15 U.S.P.Q.2d 1566 (Fed. Cir. 1990).

The claimed invention is limited so as to include formation

of a diffusion bond across an entire bonding region. Specifically, independent claim 15 recites a hollow metal article that has

> **a diffusion bond between the pair of opposed flanges, formed across the entire bond region.**

See the last two lines of claim 15.

The Gieser, Jr. *et al.* reference does not disclose formation of a diffusion bond across an entire bonding region. Moreover, it is doubtful that <u>any</u> part of the bonding taught by Gieser, Jr. *et al.* may be considered <u>diffusion</u> bonding, much less that the entire bond region is formed by diffusion bonding. The written description of Gieser, Jr. *et al.* consistently refers to welding, which is a distinct process from diffusion bonding. The distinction between mere welding and the sophisticated technique of diffusion bonding is well understood by those working in the metallurgy art. Furthermore, the distinction between welding and diffusion bonding is explained in the specification as originally filed (refer to lines 1-6 at the top of page 5).

Assuming for purposes of argument that some portion of the bond formed by the Gieser, Jr. *et al.* process would be a diffusion bond (which Appellant denies), such diffusion bond would be formed across, at most, only a portion of the bond

region between the flanges, not the entire bond region as is required by the explicit language of claim 15. The remainder of the bond region is bonded via an electrical current heat weld that melts the aluminum liner. *See* the Gieser, Jr. *et al.* disclosure at col. 3, lines 68 to 75. The fact that melting occurs (implying total dissociation of atomic bonds) clearly means that some portion of the joining in the bond region of Gieser, Jr. *et al.* falls outside the definition of a diffusion bond. By definition, diffusion bonding avoids melting of the materials being joined.

This distinction is important for forming high pressure vessels because the way the bond is formed makes a salient difference in the physical properties of the resulting vessel. It makes an order of magnitude difference in the pressures the vessel can be used for. A welded vessel is suitable to handle at most a few hundred psi of pressure. A vessel formed using diffusion bonding according to the present invention can withstand pressures on the order of thousands of psi.

For the above reasons, Appellant respectfully requests that the anticipation rejection of claims 15-18 and 20 be reversed.

Issue B => Are Claims 1, 3-14, 19, and 21 Obvious?

Claims 1, 3-14, 19, and 21 have been rejected under 35 U.S.C. § 103(a) as being obvious over Gieser, Jr. *et al.* alone. Appellant respectfully asks that this obviousness rejection be reversed for the following reasons.

In order to make out a *prima facie* case of obviousness, the prior art must teach or suggest each and every limitation of the claimed invention, because the invention must be considered as a whole. *In re Hirao*, 535 F.2d 67, 190 U.S.P.Q. 15 (C.C.P.A. 1976).

Independent method claim 1 recites the limitation

> **applying compression force to the flanges, via the tooling, at an elevated temperature so as to form a diffusion bond joint where the flanges meet**

at lines 8-10 of claim 1.

To the extent that there is any possibility that some portion of a joint formed according to the teachings of Gieser, Jr. *et al.* is diffusion bonded, such a joint cannot fairly be characterized as a "diffusion bond joint" because it is clear that Gieser, Jr. *et al.* does not place the public in possession of anything more than a method of forming a weld joint.

Independent claim 7 is directed to a bond joint and recites

> **a diffusion bond between the pair of opposed flanges, formed across the entire bond region.**

See the last two lines of claim 7. Independent bond joint claim 21 is also directed to a bond joint and recites a similar limitation. *See* lines 6-7 of claim 21. Claim 19 recites (via its dependency from independent claim 15) a hollow metal article that has

> **a diffusion bond between the pair of opposed flanges, formed across the entire bond region.**

See the last two lines of claim 15.

The Gieser, Jr. *et al.* reference does not disclose formation of a diffusion bond across an entire bonding region. Moreover, it is doubtful that <u>any</u> part of the bonding taught by Gieser, Jr. *et al.* may be considered <u>diffusion</u> bonding, much less that the entire bond region is formed by diffusion bonding. The written description of Gieser, Jr. *et al.* consistently refers to welding, which is a distinct process from diffusion bonding. The distinction between mere welding and the sophisticated technique of diffusion bonding is well understood by those working in the metallurgy art. Furthermore, the distinction between welding and diffusion bonding is explained in the specification as originally filed (refer to lines 1-6 at the top of page 5).

Assuming for purposes of argument that some portion of the bond formed by the Gieser, Jr. *et al.* process would be a diffusion bond (which Appellant denies), such diffusion bond would be formed across, at most, only a portion of the bond region between the flanges, not the entire bond region as is required by the explicit language of claims 7 and 15. The remainder of the bond region is bonded via an electrical current heat weld that melts the aluminum liner. *See* the Gieser, Jr. *et al.* disclosure at col. 3, lines 68 to 75. The fact that melting occurs (implying total dissociation of atomic bonds) clearly means that a substantial portion of the joining in the bond region of Gieser, Jr. *et al.* must fall outside the definition of a diffusion bond. By definition, diffusion bonding avoids melting of the materials being joined.

Thus, there is certainly a difference between the claimed invention and the prior art. It is clear from the analysis in the final Office Action that the Examiner does not appreciate the distinction between welding and diffusion bonding.

It would not have been obvious to modify the bonding technique of Gieser, Jr. *et al.* to form a diffusion bond joint because Gieser, Jr. *et al.* expressly teaches against broad

application of force and focuses, rather, on the narrow application of force in only a portion of the bonding region as being a critical feature of their invention's dual metal wall welding technique. *See* Gieser at col. 3, lines 48 to 60. Application of an even force application is an essential aspect of diffusion bonding and the prior art clearly teaches the omission of force application for a substantial portion of the intended bond region. Such a teaching away by the prior art from making the hypothetical modification cannot be ignored and must be taken into account in any obviousness analysis. *See W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 U.S.P.Q. 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984). The Examiner has not done this because he has not presented any evidence or reasoning explaining why these teachings would have been disregarded by a person of ordinary skill in the art.

Furthermore, it would not have been obvious to modify the bonding technique of Gieser, Jr. *et al.* to form a diffusion bond joint because such a modification would require a number of major changes to the Gieser, Jr. *et al.* technique. For example:

- Bonding would need to be accomplished all at once and evenly around the entire joint circumference in a process that takes several hours to complete. The

rolling weld configuration disclosed by Gieser, Jr. *et al.* for progressively bonding around the joint would almost certainly need to be modified to a static configuration to have any chance of forming a successful diffusion bond joint.

- The temperature would need to be well controlled so as to approach, but not exceed, the melting point of the metal being bonded.
- The pressure applied to the bond joint would need to be on the order of a few thousand psi.
- The tooling used to apply pressure to the bond joint would need to be made from materials selected for having high strength at high temperature.
- The bonding process would preferably to be conducted under an argon atmosphere in a high pressure HIP chamber. Such chambers are available at only a few locations in the U.S.

These changes are so substantial that they go well beyond the scope of "obvious matters of engineering design choice." Rather, these changes represent substantial engineering barriers that would almost certainly deter anyone making steel water heater tanks (the art to which Gieser, Jr. *et al.* is directed) from even thinking about using diffusion bonding.

Moreover, the distinction between welding (prior art

technique) and diffusion bonding (claimed invention) is important for forming high pressure vessels because the way the bond is formed makes a salient difference in the physical properties of the resulting vessel. It makes an order of magnitude difference in the pressures the vessel can be used for. A welded vessel is suitable to handle at most a few hundred psi of pressure. A vessel formed using diffusion bonding according to the present invention can withstand pressures on the order of thousands of psi.

It may be tempting to view the bond joint claims (claims 7-14 and 21) and article claims (claims 15-20) as being product-by-process claims that are not distinguishable from the prior art based on the fact that they are formed using a particular bonding technique. However, that would not be an appropriate application of the law to the facts of the present application. That is because the formation of diffusion bonds in these products makes a material difference in the physical properties of the resulting products. The decision of *In re Tanczyn*, 202 F.2d 785, 97 U.S.P.Q. 150 (C.C.P.A. 1953), is on point.

The facts in *Tanczyn* involved a claim for an article of manufacture made from a new steel alloy that had identifiable properties attributable to the new alloy. The court found

patentability on the *Tanczyn* facts because neither of the applied prior art references was concerned with solving the same problems as was the appellant, nor did the prior art references suggest a solution for eliminating such a problem. *See Tanczyn*, 202 F.2d at 787, 97 U.S.P.Q. at 152. This is very similar to the present facts because Gieser, Jr. *et al.* is not concerned with the problem of forming hollow articles out of beryllium that will withstand internal pressures on the order of thousands of psi, which Appellants have solved by the claimed invention, and because Gieser, Jr. *et al.* does not suggest any solution to this problem, much less the claimed solution.

Additionally, the *Tanczyn* court identified the fact that the claimed invention was an article of manufacture that recited the specific characteristic of being made from steel that is "substantially free of surface defacing complex silicate inclusions". *See Tanczyn*, 202 F.2d at 788, 97 U.S.P.Q. at 153. Similarly, independent claims 7, 15, and 21 on appeal recite an article of manufacture formed with a diffusion bond "across the entire bonding region". Thus, a common aspect of the *Tanczyn* case and the present case is that the claims recite a meaningful result of the claimed incorporation of a particular formation process

into a particular article of manufacture. Appellants respectfully submit that this appeal is not about an old article formed by means of a particular process. Rather, this appeal is about an article that is made using a particular process to produce a result that solves problems applicable to that article.

For the above reasons, Appellant respectfully submits that the Examiner has failed to establish a *prima facie* case of obviousness with respect to claims 1, 3-14, 19, and 21. Accordingly, Appellant respectfully requests that the obviousness rejection of claims 1, 3-14, 19, and 21 be reversed.

IX. CONCLUSION

For the above reasons, Appellant respectfully requests reversal of the anticipation rejection of claims 15-18 and 20, and reversal of the obviousness rejection of claims 1, 3-14, and 19.

The present Brief on Appeal is being filed in triplicate.

Appellant hereby petitions for any extension of time that may be required to maintain the pendency of this case, and any required fee for such extension is to be charged to Deposit Account No. 18-1579.

Respectfully submitted,

Kevin L. Pontius
Reg. No. 37,512

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APPENDIX

Claims 1 and 3-21 as finally rejected:

1. *(Amended)* Method of bonding metal shells to form a vessel having an interior void, the method comprising:

forming each of the metal shells with a peripheral flange;

aligning the metal shells with one another such that their respective peripheral flanges are engaged with one another;

assembling the aligned metal shells with tooling to engage the flanges; and

applying compression force to the flanges, via the tooling, at an elevated temperature so as to form a diffusion bond joint where the flanges meet;

wherein the region where the flanges engage one another defines a bond region, and wherein the compression force is applied broadly across the flanges so as to cover at least the bond region.

3. The method of bonding recited in claim 1, wherein the bond joint is formed entirely over the region where the flanges engage one another.

4. The method of bonding recited in claim 1, wherein the metal shells are formed of beryllium or a beryllium alloy.

5. The method of bonding recited in claim 1, wherein the elevated temperature is in the range of about 1700° F to 1750° F.

6. The method of bonding recited in claim 1, wherein the compression force is in the range of about 2000 psi to 2500 psi.

7. A metal bond joint for use with hollow articles formed from metal shells, the bond joint comprising:

a pair of opposed flanges in contact with one another, each of the opposed flanges being disposed at the periphery of one of the metal shells, the flanges being aligned with one another and defining a bond region where they are in contact with one another; and

a diffusion bond between the pair of opposed flanges, formed across the entire bond region.

8. The metal bond joint recited in claim 7, wherein the flanges are shaped such that a gap, preventing contact of the flanges with one another, is formed in an area between the shells so as to prevent the bond region from extending into the area between the shells.

9. The metal bond joint recited in claim 7, wherein the bond joint is free of filler metal.

10. The metal bond joint recited in claim 7, wherein the metal of the bond joint is homogeneous.

11. The metal bond joint recited in claim 7, wherein the bond joint is formed of beryllium or a beryllium alloy.

12. The metal bond joint recited in claim 7, wherein the diffusion bond is formed by applying compression force to the flanges at an elevated temperature.

13. The metal bond joint recited in claim 12, wherein the elevated temperature is in the range of about 1700° F to 1750° F.

14. The metal bond joint recited in claim 12, wherein the compression force is in the range of about 2000 psi to 2500 psi.

15. A hollow metal article comprising:

a pair of opposed metal shells, and

a metal bond joint, the bond joint comprising:

a pair of opposed flanges in contact with one another, each of the opposed flanges being disposed at the periphery of

one of the metal shells, the flanges being aligned with one another and defining a bond region where they are in contact with one another; and

a diffusion bond between the pair of opposed flanges, formed across the entire bond region.

16. The hollow metal article recited in claim 15, wherein the flanges are shaped such that a gap, preventing contact of the flanges with one another, is formed in an area between the shells so as to prevent the bond region from extending into the area between the shells.

17. The hollow metal article recited in claim 15, wherein the bond joint is free of filler metal.

18. The hollow metal article recited in claim 15, wherein the metal of the bond joint is homogeneous.

19. The hollow metal article recited in claim 15, wherein the bond joint is formed of beryllium or a beryllium alloy.

20. The hollow metal article recited in claim 15, wherein the diffusion bond is formed by applying compression force to the flanges at an elevated temperature.

21. A homogeneous bond joint for use with hollow beryllium articles formed from beryllium shells, the bond joint comprising:

a pair of opposed beryllium flanges in contact with one another, each of the opposed flanges being disposed at the periphery of one of the beryllium shells, the flanges being aligned with one another and defining a bond region where they are in contact with one another; and

a diffusion bond between the pair of opposed flanges, formed across the entire bond region;

wherein the flanges are shaped such that a gap, preventing contact of the flanges with one another, is formed in an area between the shells so as to prevent the bond region from extending into the area between the shells;

wherein the diffusion bond is formed by applying compression force to the flanges at an elevated temperature.